UNITED STATES DEPARTMENT OF AGRICULTURE

FOREST SERVICE

No list Publications

CENTRAL STATES FOREST EXPERIMENT STATION

ANNUAL INVESTIGATIVE REPORT FOR 1932

AND PROGRAM FOR 1933

(Calendar Years)

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Branch of Research

Forest Service - U. S. Department of Agriculture

CENTRAL STATES FOREST EXPERIMENT STATION

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(Calendar Years)

CENTRAL STATES REGION

Ohio
Indiana
Illinois
Iowa
Missouri
Western Kentucky
Western Tennesee
Northern Arkansas

CENTRAL STATES FOREST EXPERIMENT STATION

Offices: 208-209 Horticulture and Forestry Building,
Ohio State University, Columbus, Ohio.

FOREST SERVICE PERSONNEL - 1932

Willis M. Baker	Director
John T. Auten	Silviculturist
Leonard F. Kellogg	Associate Silviculturist
Ralph K. Day	Assistant Silviculturist
John G. Kuenzel	Junior Forester
Boyd B. Parker*	Senior Clerk
Charlotte Huston	Junior Clerk-Stenographer
Oliver D. Diller	Field Assistant
Johnston C. Craig	Field Assistant
Clyde R. Cochran	Field Assistant
William A. Medesy	Field Assistant
Oliver T. Dresbach	Field Assistant

BUREAU OF ENTOMOLOGY

Ralph C. Hall	Assistant Entomologist
William H. Cummings	Field Aid
Lyall E. Peterson	Assistant Field Aid
Charles C. Foster	Field Assistant

*Transferred to Station in May, 1932, to fill vacancy caused by resignation of Ruth G. Ent.

CENTRAL STATES FOREST RESEARCH COUNCIL

January 1, 1933

Alexander Thomson, Pres. C. V. Anderson, Vice-Pres. W. M. Baker, Sec.

OHIO

C. Vivian Anderson, Insurance, Union Trust Bldg., Cincinnati.
C. A. Dyer, Agricultural Legislative Agent, Southern Hotel, Columbus.
Edmund Secrest, State Forester, Wooster.
Alexander Thomson, Champion Coated Paper Company, Hamilton.
Dr. E. N. Transeau, Botany Department, Ohio State University, Columbus.

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Tom L. Wheeler, Editor, Indiana Farmer's Guide, Huntington.
Ralph Wilcox, State Forester, Indianapolis.

ILLINOIS

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R. B. Miller, Department of Conservation, Springfield.
Earl C. Smith, Illinois Agri. Asso., 608 S. Dearborn St., Chicago.
Dr. William Trelease, Botany Dept., Univ. of Illinois, Urbana.

IOWA

Chas. E. Hearst, Iowa Farm Bureau, 410 Observatory Bldg., DesMoines.
G. B. MacDonald, Forestry Dept., Iowa State College, Ames.

MISSOURI

R. W. Brown, Missouri Farm Bureau, Jefferson City.
E. E. Pershall, Moss Tie Company, St. Louis.
Paul C. Stark, Nurseryman, Louisiana.

KENTUCKY

Chas. F. Huhlein, Bernheim Estate, 139 S. First St., Louisville.
W. E. Jackson, Jr., State Forester, Frankfort.

TENNESSEE

James O. Hazard, State Forester, Nashville.

CENTRAL STATES FOREST EXPERIMENT STATION

ANNUAL INVESTIGATIVE REPORT FOR 1932

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GENERAL

Forestry and the Depression. Along with its harmful effects, the depression has had a beneficial sobering influence upon the American people. It has forced them to think seriously of the future, and to lay their plans wisely. It has brought them to that frugal state of mind essential to an acceptance and approval of conservation principles, as contrasted with extravagant exploitation. There is now apparent a very decided trend of public interest in constructive governmental enterprises, not only to combat the depression, but to provide for the future welfare of the Nation. This promises to develop into universal approval of and demand for public conservation policies, with sound management and economical use of all natural resources. Forestry has long needed just such an impetus.

Land Use in the Central States. This gratifying development of the realization of public responsibility in conservation matters has nowhere been exhibited more plainly than in the growing concern over the problems of land use. It has always been assumed that American initiative would find ways to make and keep land productive. Now we suddenly realize that over vast areas private enterprise has operated to rob the land of its usefulness, and then has abandoned it, practically worthless, to the public. To find that this has been done on a large scale in the chief region of agricultural production has proved most disconcerting. Tax delinquency, land abandonment, destructive erosion and uncontrolled streamflow, with general forest and agricultural impoverishment, have at last emphasized the necessity for a constructive forestry program in the Central States, where heretofore it has been given little concern. Apparently it required a drastic depression to bring forestry to the prominent position it now commands.

The Copeland Report. In times of economic stress and changing conditions, stock taking is essential to the welfare of any enterprise. During 1932 forestry has profited by such an undertaking. As the result of Senate Resolution 175, submitted by Senator Copeland of New York and approved by Congress on March 10, 1932, the U. S. Forest Service was called upon to prepare a comprehensive report on the Nation's forest condition and problems. This embodied a most searching investigation of past progress, present status and future requirements, carefully coordinated with associated projects of conservation in relation to many phases of the land use problem.

The Central States Forest Experiment Station, with the aid of Federal, State, and local officials and others, contributed the information dealing with the Central States, after several months of work on the part of the entire staff. Many sources of information were used from all parts of the region, with the result that much of the data compiled becomes available for the first time. It will serve the useful purpose of emphasizing the importance of forestry in the Central States to a degree hitherto unappreciated. The final report, submitted to Congress in March, 1933, should enable many of us to conceive the real magnitude of the job ahead. The Station submitted the Central States section of the investigation early in October. Baker and Kellogg spent several months in Washington assisting with the preparation of the final report. The time and effort required by this investigation naturally resulted in some curtailment of field work of the regular research projects. As a result of the Copeland Report, however, we have a very much better understanding of the forest conditions and problems of the Central States, and we have also had the opportunity of emphasizing the outstanding facts in a way that should help the progress of forestry in the region.

Research Council Meeting. The annual meeting of the Central States Research Council was held at the Brown Hotel, Louisville, Kentucky, on the evening of November 18, in conjunction with the Central States Forestry Congress. The following members were present: C. V. Anderson, President; W. M. Baker, Secretary; J. O. Hazard, C. F. Huhlein, W. E. Jackson, W. F. Lodge, G. B. MacDonald, Edmund Secrest, and E. N. Transeau. Mr. Alexander Thomson, President of the Champion Coated Paper Company, Hamilton, Ohio, was elected president of the Research Council for 1933.

The guests invited to the dinner meeting included the following:

W. E. Difford, Louisville, Ky., Pres. of the C. S. For. Congress
Franklin Reed, Washington, D. C., Exec. Secy., Soc. of Amer. Foresters
S. B. Locke, Conservation Director, Izaak Walton League, Chicago, Ill.
E. F. McCarthy and Clyde Leavitt, N. Y. State College of Forestry.
H. B. Wales and W. L. Barker, U. S. Forest Service, Milwaukee, Wis.
E. M. Bruner, U. S. Forest Service, Louisville, Kentucky
W. K. Williams, Extension Forester, Washington, D. C.
L. B. Springer and S. S. Locke, Div. of Forestry, Springfield, Ill.
L. E. Sawyer, Extension Forester, Urbana, Illinois.
H. C. Sampson and E. G. Wiesehuegel, Ohio State University, Columbus, O.
Members of the Staff of the Central States Forest Experiment Station

Publications in Press. Auten's manuscript dealing with "Porosity and Water Absorption of Forest Soils" was submitted for publication in the Journal of Agricultural Research early in the summer. "The Regeneration of Farm Woods Following the Removal of Livestock," by Day and DenUyl is being published, under a cooperative agreement, by the Purdue Agricultural Experiment Station. McCarthy's manuscript on "Yellow Poplar" has undergone final review, and has been submitted to the Washington office for publication. These several publications are expected to appear during 1933, together with other material which the Station may prepare in mimeograph form.

ADMINISTRATION

Personnel. Ever since the Station was established in 1927, there has been a loss of efficiency due to an unavoidable shifting of personnel. During 1932, however, there was only one change, brought about by the resignation of the Senior Clerk, Miss Ruth Ent, who left in March to be married. The vacancy was filled in May by the transfer of Boyd B. Parker from the Apache National Forest in Arizona. All members of the staff were required, by the Congressional Economy Act, to forego all annual leave privileges, and to accept a month's furlough without pay, which amounts to a salary reduction of 8 1/3 per cent.

Headquarters and Equipment. In June Ohio State University provided the Station with approximately one thousand square feet of additional floor space in the adjoining Room 208, Horticulture and Forestry Building. Additional office furniture and equipment were purchased, portable partitions were built, and the new quarters were ready for occupancy in July. Two new Ford trucks were added to the Station's equipment in July, and one used truck was turned in. In December the University transferred the Station cars to a more spacious and convenient garage. Accordingly, excessive crowding has been remedied, and the Station's headquarters situation is much improved. There is still need for more laboratory and work room space. The Station's photograph, lantern slide and compilation files have undergone complete revision, but the library still requires considerable additional work to put it in good shape. A few new books and a large number of bulletins and publications have been added to it.

Public Relations. The staff of the Station participated in a number of forestry and conservation meetings during the year, and on several occasions contributed papers or talks. Baker read papers at the Central States Forestry Congress and the Ohio Forestry Association meetings, and gave talks to various Columbus organizations on four other occasions; Auten contributed a paper to the American Soil Survey Association, and spoke at the Central States Forestry Congress and Ohio Forestry Association meetings; Hall read a paper at the Michigan Academy of Science meeting; and Day spoke at the annual meeting of the Ohio Valley Section, Society of American Foresters. The usual forestry lectures and talks were given to the Ohio State University forestry students by all members of the staff.

A popular article, "Pioneers and Virgin Hardwoods" written by Auten, appeared in the September Issue of American Forests. In November the Station prepared and distributed a brief progress report covering five years of the Station's activity. Several special articles concerning the Station's work appeared in the press from time to time, as well as in professional and scientific journals.

Miscellaneous. Forest Service visitors to the Station from Washington during 1932 included Assistant Forester Earle H. Clapp in June and again in August, F. X. Schumacher in May, Paul H. Roberts in August. District Inspector Bruner of Louisville spent a week at the Station in September, working on the Copeland Report, and Assistant Regional Forester H. B. Wales spent several days with us in November. Former director E. F. McCarthy visited the Station in November and again in December.

In June Baker, Auten, and Kellogg visited the Kane Experimental Forest of the Allegheny Station in northwestern Pennsylvania, and conferred with the directors and members of the Allegheny and Northeastern Stations regarding reforestation problems and projects. Baker made special trips in June and July to inspect forest conditions on the State Forests of Ohio, Indiana, and Illinois. In September Baker and Kuenzel made a two weeks' trip around the region, spending most of the time in Missouri, Arkansas and Tennessee, making contacts and securing data on forest conditions.

Distribution of Expenditures

Project	Fiscal Year 1932 7-1-31 to 6-30-32	First half of Fiscal Year 1933 7-1-32 to 12-31-32	Estimated For Second half of Fiscal Year 1933 - 1-1-33 to 6-30-33
Fp-1 Plantations	10,701.12	3,691.30	1,600.00
M-1 Forest Sites	9,424.97	2,941.74	5,600.00
M-2 Farm Woodlands*	8,207.38	2,375.34	4,000.00
M-3 Upland Forest Management (Formerly TS-12 and ME-2)	471.98	24.89	739.98
Yellow Poplar	433.02	----	----
Extensive Revision	1,542.29	----	----
Copeland Report	----	5,224.35	2,000.00
Total	$30,780.76	14,257.62	13,939.98
Locust Borer (Bureau of Entomology)	$ 6,400.00	4,000.08	3,229.92

*During 1932 the Purdue Agricultural Experiment Station contributed approximately $1,500.00 in time and money to the woodland grazing study.

Distribution of Time - 1932

Total days' work - permanent staff = 2,229
" " " - temporary assistants = 768
Total = 2,997

Field Work By States

States	Days' Field Work
Ohio	194
Indiana	476
Illinois	76
Iowa	3
Missouri	10
Arkansas	8
Kentucky	50
Tennessee	73
Other States----------(chiefly by Entomologists)----------	160
Washington, D. C. ----------(Kellogg)----------	183
	1,233

RESEARCH INVESTIGATIONS

FOREST SITE PROJECT (M-1)

Dr. John T. Auten

Porosity and Water Absorption of Forest Soils. The comparative study of forest and field soils, with regard to their relative density, porosity, and ability to absorb and hold water, was completed by Auten early in 1932. The manuscript entitled "Porosity and Water Absorption Capacity of Forest Soils" was submitted to the Journal of Agricultural Research for publication in April. It is expected to appear in print before July 1, 1933.

Base Exchange Study. As a phase of the investigation of differences in forest and adjacent field soils, Auten has completed a series of base exchange determinations. The study was made on the same sites used for the porosity studies (20 old-growth forest sites in Ohio, Indiana, Illinois and Michigan), to determine the loss of exchangeable calcium and magnesium after clearing and cultivation of forest lands. This study is directed toward a better understanding of the difficulties encountered in reforesting abandoned fields. It is planned to submit the completed report for publication during 1933. The following conclusions have been reached:

1. Litter from trees grown on calcareous soil contains a much higher percentage of replaceable calcium than does litter of the same species grown on siliceous soil. The same is true of magnesium except that the difference is less.

2. Of the calcium and magnesium bases found in forest soils, very large amounts are lost from the surface horizon following cultivation.

3. The subsoil of fields apparently increases its replaceable base content, following clearing and cultivation.

Study of Plantation Sites of Black Walnut. In the summer of 1932 Auten, assisted by Kuenzel, started a study of forest plantation sites, to determine the factors which make for good or poor growth of the species planted. This determination of the site requirements of important tree species is essential to the development of the parent project of forest litter investigations, and at the same time is of immediate value to the forester or prospective forest planter who must know in advance of planting for what species his lands are suited.

Black walnut plantations were chosen to start this study, because walnut is a valuable species of rather exacting site requirements, extensively planted in the Central States, and because plantation plots, established by Kellogg in his study of growth, yield and volume, were already available. Kellogg has classified these plots by quality of site, according to the height of dominant trees at a given age. The purpose of Auten's work was to determine the outstanding factors which characterize these different qualities of site.

The first field work on this project was undertaken from July 15 to August 15 in the black clay-brown silt loam area of eastern Illinois. This particular area was selected for the initial study because a relatively large number of black walnut plantation plots are grouped within a small area in Champaign and Vermillion Counties. In the determination of factors governing good or poor growth, that of climatic variation was thereby eliminated from the initial study. Moreover, these same counties are largely covered by one soil area or type series, the soil being either black clay loam or brown silt loam. By selecting an area for the initial study where soil variation from type was at a minimum, the preliminary work was further simplified.

It is possible at this time to make a few tentative statements based on the preliminary observations of the study. As the project develops, some of these statements may require modification, since they are based largely on initial work on the prairie soils of eastern Illinois.

1. It appears probable that the determination of the suitability of a site for black walnut may be based almost entirely upon field observations and tests. If this proves true, it will not only simplify the conduct of this and similar studies, but will also make it possible with relatively simple instructions to guide the layman in the selection of planting sites.

2. Although pH determinations were made carefully in approximately 150 soil horizons on more than 50 walnut plots which varied greatly in site quality, no apparent correlation has been observed between rate of growth and pH of the soil.

3. A very striking correlation was found to exist between walnut growth and the presence of a compact B or subsoil horizon. In every instance it was observed that walnut roots did not penetrate a tight subsoil, and growth was invariably poor where such a condition existed.

4. Walnut was found to grow best where there was abundant moisture with adequate drainage. Good growth was commonly found on terraces adjacent to streams and in sheltered coves, where soil moisture was plentiful, and where the soil was loose in structure, deep and well drained. Light as well as dark colored soils were found to favor good growth provided the elements of moisture and drainage were optimum.

5. Walnut invariably grew poorly on soils that had developed a compact B horizon, on those that were poorly drained, and on soils deficient in moisture. Apparently walnut should never be planted on shallow soils, nor on dry hills and moraines. The black clay loam soil of the prairies is not suitable for walnut because of poor drainage.

6. Soil type provides no criterion for determining suitability for the growth of a species, except in a very general way. Certain soil types may provide unfavorable conditions for growth, whereas others may be generally good; yet within the more favorable type there will be found great variation due to purely local conditions. Within a plantation of a few acres, great variation is often found in walnut growth, where no surface variation in soil type is apparent.

Field work in eastern Illinois was interrupted in the middle of August, when Auten and Kuenzel returned to Columbus to assist with the Copeland report, but was resumed in October, when black walnut plots were studied in Indiana, Ohio and Kentucky. Since the close of the field season the project has been continued by the compilation of field data and by the analysis of soil samples in the laboratory.

In 1933 it is planned to undertake a similar study of black locust sites, using the growth and yield plots already established. It is necessary to complete this study early in the year, in order that the data may be made available for Hall's investigation of the locust borer. As soon as the locust site study is completed, it is planned to return to the examination of black walnut plots in Iowa, and to study the sites where natural black walnut is found, or where it was abundant formerly, as witnessed by the stumps of logged stands. This latter phase of the study is considered important, since a great many of the present walnut plantations are found on prairie soils when no tree growth occurred naturally.

FARM WOODLAND MANAGEMENT PROJECT (M-2)

Ralph K. Day

The empirical methods which have been employed during the early stages of the preliminary study of the relation of grazing to farmwoods, have provided the Station with much valuable data. It has become increasingly evident, however, that many of the questions which remain to be answered before a complete analysis of the problem can be made, are of such a nature as to require intensive study of carefully controlled plots over a period of years. It is also evident that, as rapidly as our resources permit, this project should be extended by studies of the silvicultural management of farmwoods. The results of past work and plans for the future of this project are discussed for each of the several phases of the woodland grazing study originally set up.

The Reconnaissance Phase, which represents the preliminary survey of the region to determine the extent and importance of the problem in the Central States, has been completed except for the publication of the data in report form. Present restrictions on government printing will undoubtedly delay the appearance of a bulletin, but the Station expects to prepare a condensed mimeographed report during 1933.

The Reconstruction Phase of the woodland grazing study is being carried on in Indiana in cooperation with the Department of Forestry of the Purdue Agricultural Experiment Station. During the past two field seasons approximately seventy-five study plots, ranging in size from one-fourth to one acre, have been established for the purpose of determining the ability of farmwoods to regenerate naturally following the removal of livestock. The plots are permanent in character, located chiefly in farm woodlands classified under the Indiana Forest Tax Law. The trees, reproduction, shrubby and herbaceous vegetation have been recorded, mapped and tagged, so as to permit accurate remeasurement of growth and other changes which take place during the regeneration period.

The field work in 1932 consisted largely of plot establishment, and remeasurement of previous plots. For the field crew the Central States Station reemployed Oliver D. Diller, a graduate student of forest ecology at Ohio State University, and the two Stations shared the expense of employing William Medesy, a forester from Purdue University, now taking graduate work at Yale. This crew started work on May 24 under Day's supervision and continued through the summer until September 15, for the greater part of the time under the supervision of Daniel DenUyl of the Purdue Station.

The Reconstruction phase of this study has progressed sufficiently far to justify the publication of a progress report, covering the results of two years' work. This report has been published by the Purdue Agricultural Experiment Station under the title: "National Regeneration of Farmwoods Following the Removal of Livestock."

It is believed that enough study plots have now been established to determine what takes place in grazed woods after livestock are removed. It is planned to remeasure these plots annually for four years, biannually for the next six years, and then perhaps every five years. In the case of certain selected plots monthly examinations may be made to determine the ecological and other factors controlling the germination, establishment and survival of tree species. Frequent remeasurements during the early stages are necessary because of the complete lack of data regarding the causes of the very marked changes that occur from year to year, and even from month to month in some instances.

The lack of reproduction on some areas from which livestock has been excluded for several years, has been attributed largely to absence of seed years, but the examination of plots in 1932 indicated that there are other reasons to be considered. A very good seed crop of many species occurred in 1931, and conditions for germination were favorable in the spring of 1932. Accordingly, abundant reproduction was expected on many plots. Early germination was excellent, but reexamination of plots at intervals during the summer indicated that the seedlings were unable to become permanently established. Apparently the roots were unable to penetrate the compacted soil sufficiently to survive the summer droughts.

The effect of this low survival on plots formerly heavily grazed is reflected in a complete change in the character of tree reproduction from year to year. Certain species germinating in the spring of 1931 were in evidence during the summer of that year, but had completely disappeared by fall, and a new crop of seedlings of another species occupied the ground the following spring. Apparently this process takes place repeatedly with the result that reproduction in these heavily grazed woods is very slow in becoming established. On one plot, ungrazed for nearly 20 years, less than one per cent of the reproduction had reached a size of 0.6 inch in diameter at breast height.

The Livestock Management Phase. No systematic appraisal of livestock carrying capacity has ever been attempted for the hardwood forests of the eastern United States, but it is obvious that this must be accomplished before any adequate solution of the woodland grazing problem can be reached. In the spring of 1931 an experiment was initiated to determine the actual forage value of farmwoods in terms of pounds of beef produced. This study is also being conducted in cooperation with the Purdue Agricultural Experiment Station. The oak-hickory woodland on the Pinney-Purdue Farm at

Wanatah, Indiana is being used for the tests. Three tracts of woodland pasture consisting of 6, 12, and 18 acres each have been fenced, and are being grazed by yearling steers. Each tract is stocked with 3 animals, thereby creating grazing intensities of 2, 4, and 6 acres per animal unit. The steers have been placed in these pastures about May 1 of each year and kept there until October 30, until the herbaceous and shrubby vegetation had been completely utilized, or until three successive weekly weighings indicated no gain or a loss for all three animals. Dr. Cain of Indiana University has assisted during the past two seasons with a quadrat study of vegetative changes.

The results of the first two years indicate that one additional season (1933) should provide sufficient data to determine the forage value of this particular type of woods. While definite conclusions cannot be drawn at the present time, the following general observations may be of interest.

1. The Oak-hickory woods were incapable of producing forage sufficient even to sustain the original weights of steers over a six months' grazing season, on the basis of any of the three grazing intensities used.

2. Computing the weights at the period of maximum gain and converting them into terms of animal months, the data indicate that not less than 1.5 acres per animal month, or 9 acres for the six months' period, would be required to maintain an average gain of one pound per day per animal, without supplementary feeding.

3. With season-long grazing under intensities of 2 acres per animal and no supplementary feeding, all vegetation within reach of the animals was completely defoliated, and except for annuals, was largely eliminated after two years of continuous grazing.

4. Grazing under intensities of four acres per animal prevents the establishment of tree reproduction.

The Growth and Yield Phase is to determine the effect of grazing on the rate of growth of trees. Many of the permanent plots already established for the reconstruction phase will be used for periodic measurements of growth and yield. In addition, a number of adjacent paired plots, grazed and ungrazed, are being established as favorable situations are located. No significant results can be expected within less than ten years, but it is already apparent that the productive capacity of woods is seriously lowered by continuous grazing.

The Economic Phase of this study is intended to determine the relative returns to be expected from the use of farmwoods for timber and for livestock production. Some data have been collected in connection with work on other phases, but no active work is contemplated until additional funds and personnel become available.

FOREST PLANTATION PROJECT (Fp-1)

Leonard F. Kellogg

Black Walnut Study. Kellogg spent five months, January to June, in the Washington office, computing the tables of volume and yield for planted black walnut from data collected during previous field seasons. The details and methods of the work were given very careful attention, so that this project can serve as a model for similar investigations in the future. Completion of the black walnut tables was prevented by the necessity for supervision of field crews, and later by the Copeland Report. It is planned to publish at least a portion of the report in mimeographed form during 1933.

Black Locust Yield Study. The field work of establishing black locust yield plots was started early in May in Indiana where the 1931 work was suspended. Kuenzel started the work with the help of field assistant Johnston C. Craig. Since the crew secured data for the locust borer investigation as well as for the yield tables, Dr. Hall spent some time in the field with them. In July Kuenzel left the party to work with Auten, at which time William Cummings, field aid of the Bureau of Entomology for the second year, joined the crew and continued with it throughout the season. A total of 71 plots were established throughout Indiana, Illinois, Kentucky, and in western Tennessee. Field work was terminated about the middle of October. Great assistance in locating black locust plantations was given to the field party by State Foresters Miller and Locke and Extension Forester Sawyer of Illinois, and by District Forester Peck of Tennessee.

Fewer plots were established in 1932 than was the case in 1931, since this year's party undertook the work of preliminary scouting and locating plots as well as establishing them. However, with the plots established last year in Ohio and Indiana, there are now a total of 240, sufficient to provide the data necessary for yield tables. Work will be started on these tables in 1933, as soon as the walnut report is completed.

Black Locust Volume Table Measurements. In July Kellogg organized a field crew to secure tree measurement for black locust volume tables. Clyde R. Cochran, who secured the black walnut measurement the previous season, and Oliver T. Dresbach composed the party. Since felled trees from locust plantations could not be located, stem measurements were taken by climbing.

The trees chosen for measurement were selected not only for diameter and height, but also for age and spacing. Using the height-over-age scatter of plots secured in 1931 as a basis, certain groups of plots were chosen at various ages as being of good, medium or poor site. Within these groups, given stands were selected as samples, so that given spacings (e.g. 6' x 6') were represented uniformly over the universe of stands. A list of these selected plantations was then prepared for the field crew, and their measurements were confined almost entirely to these stands.

In order to sample the diameters impartially, the climber selected a row of trees through each established plot and measured from 15 to 18 trees just as they stood. The personal equation entered only in the selection of the row, the endeavor being to secure stems covering the range of diameters in that particular plot. Because the height-age limits of planted black locust were fairly well established in the field work of 1931, measurements were taken for the most part in these plantations, north of the Ohio river. A total of 394 trees were measured in Ohio, Indiana and Illinois. A few additional measurements were available from wind thrown trees measured in 1931, so that altogether data from over 400 trees have been obtained, sufficient for volume table purposes. The range of diameters extends from 1 to 20 inches (D.B.H.) and the heights from 10 to 95 feet, the limit found for planted locust in this region.

Kellogg plans to prepare volume tables for planted black locust during 1933. No field work is contemplated for this year.

MANAGEMENT OF UPLAND FORESTS (M-3)

(Formerly TS-12 and ME-2)

John G. Kuenzel

Chestnut Oak Regeneration Study. Following an abundant crop of chestnut oak acorns in 1928, regeneration plots were established in 1929 at Crystal Spring and Rock House in southern Ohio, and at Henryville in southern Indiana. The Ohio plots were located under an undisturbed crown canopy, whereas the three Indiana plots were established under conditions of clear cutting, selection cutting, and no cutting, respectively. The purpose of the study was to determine the effect of shade, tree competition, and depth of forest litter on the survival and growth of seedlings.

The third remeasurement of these plots was made in 1932. Partial analysis of the data reveals that the best survival of seedlings has occurred under undisturbed forest conditions, but that growth has remained almost stationary. Under the open canopy of the selection cutting and on the clear-cut area height growth of reproduction was greater, but drought and rodent injury continue to reduce the seedling reproduction, some of which reappear as seedling sprouts. Oak galls have also reduced the quantity of reproduction in these plots.

Another good seed crop in the fall of 1932 will undoubtedly result in a new stand of seedlings in 1933, which makes it necessary to identify the original seedlings with tags. Annual observations will be continued until the establishment and growth of chestnut oak reproduction is thoroughly understood.

LOCUST BORER INVESTIGATION

Dr. R. C. Hall, Bureau of Entomology

The locust borer presents the major forest insect problem in the Central States at the present time. Because of the large locust planting program in most of these states, it is likely to continue as an important problem for some time to come. It appears that planted material is more subject to damage by the locust borer than is natural growth, apparently because of the difference in early vigor in the two types of growth. Rate of growth of locust appears to be the outstanding factor in locust borer injury, -- the more rapid the rate of growth, the less is the locust borer injury.

Distribution of Study Plots by States. During the two field seasons of 1931 and 1932, a total of 544 study plots have been established, located according to states as shown in table No. 1. Two types of plots were used: permanent plots on which all factors which might have any bearing on the locust borer were recorded, and temporary plots on which only the factors of growth and soil were considered.

Table No. 1

State	Permanent Plots Number	Temporary Plots Number	Total Number
Ohio	139	54	193
Indiana	87	46	133
Tennessee	32	21	53
Illinois	8	13	21
Kentucky	5	50	55
Michigan	8	12	20
Penn.	20	20	40
New York	2	20	22
Mass.	0	5	5
Maryland	0	1	1
W. Va.	0	1	1
All States	301	243	544

Relationship between Rate of Growth and Locust Borer Injury. The 1931 data indicated that an important relationship existed between rate of growth and locust borer injury, and the addition of the 1932 data has served to strengthen this previous conclusion. It appears from the data at hand that it will be possible to predict the chance of severe borer injury in a plantation, using a combination of the average diameter and height growth for the first four years as a basis. This appears to have practical application by the use of small test plantings for a period of a few years, to determine the fitness of different soils for the production of locust posts or poles. In that way, some of the failures of large plantations of black locust might be avoided.

Locust Borer Damage by States. From analysis of plot data from different states, there appeared to be a difference in the amount of injury in these states. The personal selection of plots would unquestionably have an effect upon these figures, because in the strict sense of the word, they do not represent random samples. For this reason, too much importance should not be attached to the following figures. The states are listed below in order of the amount of locust borer injury, as obtained by the sample plots examined.

Table No. 2

State	Number of Plots	Locust Borer Injury
New York	22	very light
Tennessee	53	very light
Penn.	40	light
Illinois	22	light
Kentucky	55	light
Michigan	20	medium
Indiana	132	medium
Ohio	223	medium

Results of Spraying Experiments. Spray experiments were conducted both in winter and spring to test the relative effectiveness of each. Orthodichlorobenzene and kerosene were the two spray materials used. The winter spray, which was applied Dec. 6, 1931, was much less effective than was the spring spray, which was applied on May 6, 1932. It was found that orthodichlorobenzene stock solution (water 1 gallon, ortho 1 gallon, whale oil soap 1 pound) gave almost complete control (99.0%) when applied in the spring. Ortho stock solution 1 part, water 3 parts, gave almost as complete control (97.8% kill), and ortho stock solution 1 part to water 6 parts gave 96% kill. The winter sprays proved less beneficial, with a 78.6% kill being the most effective.

Locust Borer Larval Mortality. As a result of the 1931 field work, it was discovered that trees in the dominant and codominant crown classes showed much less injury than did those in the intermediate and overtopped classes. The question arose as to whether or not the locust borer adults concentrated their egg laying in the two subordinate crown classes. During the 1932 season, a study was made to determine the number of active larvae on the different crown classes early in the spring, and the number of emerging adults in the fall. As a result of this study, it appeared that the locust borer shows no definite preference as to crown classes when in the act of oviposition. It seemed more a question of chance, and an analysis of 23 sample plots disclosed that very nearly the same number of eggs were deposited in each crown class. The average number of eggs deposited per tree in the different crown classes is as follows: dominant, 21.7 larvae per tree; codominant, 27.2 larvae per tree; intermediate 24.5 larvae per tree; and overtopped, 19.6 larvae per tree.

From a count of emergence holes in the fall, it was possible to determine the mortality per cent in each crown class. The mortality per cent of the larvae showed a definite relationship to crown class and site, the more vigorous trees showing the highest mortality per cent. The dominant crown class showed an average larval mortality per cent of 95.6; the codominant crown class an average of 87.2; the intermediate crown class, 74.3; and the overtopped crown class, 52.5. It was found that on the better quality sites, a higher larval mortality obtained than on the poorer sites. Sample plots with site indices ranging from 40 to 60 feet showed an average larval mortality per cent of 75.1, those from 60 to 80 showed 81.0% kill, and those from 80 to 100 showed 93.2% kill.

This phase of the study substantiated the findings of the 1931 field season, indicating that the weaker trees in the stand act as brood trees, and it is these trees which produce practically all the adults for reinfestation. It would appear from this that sanitation cutting which would remove the weak and decrepit trees in a stand, would tend materially to reduce the amount of infestation.

Plans for 1933. It is planned to concentrate the 1933 field investigations to a study of methods of improving the vigor of locust stands as a means of combating the borer. These will consist of improvement or sanitation cuttings, pruning, thinning, cutting to induce vigorous sprouting, fertilization to induce vigorous growth, and planting methods. The 1932 spring spray experiments will be repeated in 1933, using a larger number of trees.

Larval mortality studies will be continued, using about 100 sample plots so arranged that all age classes will be represented as well as the different qualities of site. Cooperative assistance will be given in the study of locust plantation sites by Auten.